

AMENDMENT UNDER 37 C.F.R. § 1.111
U. S. Application No. 09/835,319

AMENDMENTS TO THE CLAIMS

This listing of claims will replace all prior versions and listings of claims in the application:

LISTING OF CLAIMS:

1. (previously presented): A multi-wavelength surface emitting laser for emitting light having a first wavelength and light having a second wavelength, the laser comprising:
 - a substrate;
 - a first surface emitting laser which emits light having the first wavelength, directly formed on a portion of an upper surface of the substrate and including,
 - a first lower reflector formed of two alternately deposited semiconductor material layers having a same type of impurity, but different refractive indices, the first lower reflector disposed on the upper surface of the substrate;
 - a first active layer disposed on the first lower reflector; and
 - a first upper reflector formed of two deposited semiconductor material layers having different refractive indices and an opposite type of impurity to that of the first lower reflector, the first upper reflector disposed on the first active layer;
 - a second surface emitting laser which emits light having the second wavelength, directly formed on a portion of an upper surface of the substrate neighboring the first surface emitting laser and including,
 - a second lower reflector formed of two alternately deposited semiconductor material layers having different refractive indices and a same type of impurity, the second lower reflector disposed on the upper surface of the substrate;

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a second active layer disposed on the second lower reflector; and

a second upper reflector formed of two deposited semiconductor material layers having different refractive indices and an opposite type of impurity to that of the second lower reflector, the second upper reflector disposed on the second active layer;

a lower electrode layer disposed on a lower surface of the substrate;

a first upper electrode formed on the first upper reflector, which electric power is applied to; and

a second upper electrode formed on the second upper reflector, which electric power is applied to;

wherein the first and second surface emitting lasers commonly use the substrate and the lower electrode; and

wherein each of the first lower reflector, the first active layer and the first upper reflector of the first surface emitting laser are apart and formed independently from each of the second lower reflector, the second active layer and the second upper reflector of the second surface emitting laser.

2. (original) The laser as claimed in claim 1, further comprising a first high resistance portion partially formed in the first upper reflector, which limits a flow of current; and

a second high resistance portion partially formed in the second upper reflector, which limits a flow of current.

3. (withdrawn) A method for manufacturing a multi-wavelength surface emitting laser comprising the steps of:

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forming a first surface emitting laser which emits light having a first wavelength, the forming of the first surface emitting laser including,

depositing, sequentially, on a prepared substrate a first lower reflector, a first active layer and a first upper reflector, the first lower reflector formed by; depositing, alternating, two semiconductor material layers having a same type of impurity, but different refractive indices, the first upper reflector formed by;

depositing, alternately, two semiconductor material layers having an opposite type of impurity to that of the first lower reflector and having different refractive indices;

partially removing the first upper reflector, the first active layer, and the first lower reflection layer by etching; and

forming a protection film on an outer surface of the first surface emitting laser;

forming a second surface emitting laser which emits light having a second wavelength, the forming of the second surface emitting laser including,

depositing, sequentially, on the substrate and the protection film, a second lower reflector, a second active layer, and a second upper reflector, the second lower reflector formed by;

depositing, alternately two semiconductor material layers having a same type of impurity, but different refractive indices, the second upper reflector formed by;

depositing, alternately, two semiconductor material layers having an opposite type of impurity to that of the second lower reflector and different refractive indices;

removing portions of the second lower reflector, the second active layer, and the second upper reflection layer formed on the protection film by etching; and

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removing the protection film;

forming a first upper electrode on an upper surface of the first upper reflection layer;

forming a second upper electrode on an upper surface of the second upper reflection layer; and

forming a lower electrode on a bottom surface of the substrate.

4. (withdrawn) The method as claimed in claim 3, wherein the protection film is formed of one selected from a group consisting of silicon nitride and silicon oxide.

5. (withdrawn) The method as claimed in claim 3, further comprising a step of forming first and second high resistance portions by injecting protons into part of the first and second upper reflectors before the first and second upper electrodes are formed.

6. (previously presented): A multi-wavelength surface emitting laser for emitting light having a first wavelength and light having a second wavelength, the laser comprising:

a substrate;

a first surface emitting laser which emits light having the first wavelength formed on a first portion of the substrate; and

a second surface emitting laser which emits light having the second wavelength formed on a second portion of the substrate,

wherein the first surface emitting laser includes,

a first lower reflector disposed on the substrate;

a first active layer disposed on the first lower reflector; and

a first upper reflector disposed on the first active layer, and wherein the second surface emitting laser includes,

a second lower reflector disposed on the substrate;

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a second active layer disposed on the second lower reflector; and a second upper reflector disposed on the second active layer;

wherein the first and second surface emitting lasers commonly use the substrate; and

wherein each of the first lower reflector, the first active layer and the first upper reflector of the first surface emitting laser are apart and formed independently from each of the second lower reflector, the second active layer and the second upper reflector of the second surface emitting laser.

7. (cancelled).

8. (previously presented): The laser as claimed in claim 6, wherein the first lower reflector is formed of two alternately deposited semiconductor material layers having a same type of impurity, but different refractive indices, and the first upper reflector is formed of two deposited semiconductor material layers having different refractive indices and an opposite type of impurity to that of the first lower reflector, and

wherein the second surface emitting laser is formed of two alternately deposited semiconductor material layers having different refractive indices and a same type of impurity, and the second upper reflector is formed of two deposited semiconductor material layers having different refractive indices and an opposite type of impurity to that of the second lower reflector.

9. (previously presented): The laser as claimed in claim 6, further including,
a lower electrode disposed on a lower surface of the substrate;
a first upper electrode formed on the first upper reflector, which electric power is applied to; and

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a second upper electrode formed on the second upper reflector, which electric power is applied to.

10. (original): The laser as claimed in claim 6, wherein the first surface emitting laser and the second surface emitting laser are formed on an upper surface of the substrate, and wherein the first surface emitting laser and the second surface emitting laser neighbor each other.

11. (withdrawn): A method for manufacturing a multi-wavelength surface emitting laser comprising the steps of:

forming a first surface emitting laser which emits light having a first wavelength, on a substrate; and

forming a second surface emitting laser which emits light having a second wavelength on the substrate.

12. (withdrawn): The method as claimed in claim 11, wherein the first surface emitting laser is formed by,

depositing, sequentially, on the substrate a first lower reflector, a first active layer and a first upper reflector, and wherein the second surface emitting laser is formed by;

forming a protection film on an outer surface of the first surface emitting laser; and

depositing, sequentially, on the substrate and the protection film, a second lower reflector, a second active layer, and a second upper reflector.

13. (withdrawn): The method as claimed in claim 12, wherein the first lower reflector is formed by,

depositing, alternately, two semiconductor material layers having a same type of impurity, but different refractive indices, and wherein the first upper reflector is formed by;

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depositing, alternately, two semiconductor material layers having an opposite type of impurity to that of the first lower reflector and having different refractive indices, and wherein the second lower reflector is formed by;

depositing, alternately two semiconductor material layers having a same type of impurity, but different refractive indices, and wherein the second upper reflector formed by;

depositing, alternately, two semiconductor material layers having an opposite type of impurity to that of the second lower reflector and different refractive indices.

14. (withdrawn): The method as claimed in claim 12, further including,
removing portions of the second lower reflector, the second active layer, and the second upper reflection layer formed on the protection film by etching; and
removing the protection film.

15. (withdrawn): The method as claimed in claim 14, further including;
forming a first upper electrode on an upper surface of the first upper reflection layer;
forming a second upper electrode on an upper surface of the second upper reflection layer; and

forming a lower electrode on a bottom surface of the substrate.

16. (previously presented): A multi-wavelength surface emitting laser for emitting light having a first wavelength and light having a second wavelength, the laser comprising:
a substrate;
first laser emitting means for emitting a laser having the first wavelength, the first laser emitting means disposed on the substrate; and

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second laser emitting means for emitting a laser having the second wavelength, the second laser emitting means disposed on the substrate,
wherein the first laser emitting means includes,
first laser reflecting means disposed on the substrate; and
first energy transition means for generating a laser beam, the first energy transition means disposed in the first reflecting means, and
wherein the second laser emitting means includes,
second laser reflecting means disposed on the substrate; and
second energy transition means for generating a laser beam, the second energy transition means disposed in the second reflecting means;
wherein the first and second laser emitting means commonly use the substrate; and
wherein the first laser reflecting means and the first energy transition means of the first laser emitting means are apart and formed independently from the second laser reflecting means and the second energy transition means of the second laser emitting means.

17. (cancelled).

18. (previously presented): The laser as claimed in claim 16, further including:
lower electrode means disposed on a lower surface of the substrate;
first upper electrode means for accepting electric power disposed on an upper surface of the first laser reflecting means; and
second upper electrode means for accepting electric power disposed on an upper surface of the second laser reflecting means.

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19. (new): The multi-wavelength surface emitting laser of claim 1, wherein the first and second lower reflectors have different heights.

20. (new): The multi-wavelength surface emitting laser of claim 6, wherein the first and second lower reflectors have different heights.

21. (new): The multi-wavelength surface emitting laser of claim 16, wherein the first and second laser reflecting means have different heights.